Nanoscale imaging of electrochemical energy conversion and storage systems

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Chemistry Seminar on Nanoscale imaging of electrochemical systems

4:00 p.m.
Monday
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Via Zoom

Please contact Dr. Amitava Choudhury at choudhurya@mst.edu for the zoom link.

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Abstract: Energy needs and environmental trends demand a large-scale transition to clean, renewable energy. Nanostructured materials are poised to play an important role in this transition. We strive to understand the correlation between nanoparticle chemistry/structure and functional properties. The first part of my talk will focus on elucidating charge storage mechanisms in nanoscale materials related to electrochemical technologies such as batteries and smart windows. I will discuss our high-throughput electro-optical imaging method that measures the battery-like and capacitive-like (i.e., pseudocapacitive) charge storage contributions in single metal oxide nanoparticles. I will present our recent single particle-level measurements that show (1) individual particles exhibit different charge storage mechanisms at the same applied potential and (2) particle size-dependent pseudocapacitive charge storage properties. The second part of my talk will focus on solar energy conversion using ultrathin semiconductors such as monolayer-thick (ML) two-dimensional (2D) materials such as MoS_2 and WS_2. We developed a correlated laser reflection and scanning photocurrent microscopy approach to study how layer thickness and surface structural features (edges versus basal planes) influence solar energy conversion efficiency. I will highlight our photocurrent microscopy study that revealed how layer stacking order in heterojunction photoelectrodes influences charge separation, transport, and recombination pathways.

About the speaker: Justin earned his B.S. degree in 2006 from the State University of New York (SUNY)-Binghamton. His undergraduate honors thesis work was done under the direction of Dr. David Doetschmann and focused on the degradation mechanisms of chemical warfare agents within zeolite pores. Justin then traveled west to graduate school and earned his PhD with Prof. Bruce A. Parkinson at Colorado State University (CSU), where he studied the photoelectrochemical energy conversion properties of semiconductor nanocrystals and light absorbing polymers on single crystal electrode surfaces. In 2011, Justin traveled back to NY to join Prof. Peng Chen's lab at Cornell University as NSF ACC-F Postdoctoral Fellow where he worked on integrated single molecule imaging methods in the area of photoelectrochemistry. Justin returned to CSU in 2016 as an Assistant Professor of Chemistry and the School of Advanced Materials Discovery (SAMD). His current research has been recognized with the Air Force Young Investigator Award, NSF CAREER Award, and DOE Early Career Award. Justin was also named a Scialog Fellow in Advanced Energy Storage.